



Idaho National Laboratory

# DOE's EGS Program Review

## INL EGS Research Projects

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# Numerical Tools for Reservoir Management

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# **Project Objective**

**Prepare final report on development of improved numerical simulation of geothermal reservoirs.**

# EGS Problem

- **As in all geothermal reservoirs, understanding fluid flow is the key to proper reservoir management.**
- **ISSUE: Reservoir operation and management**
- **Most recent work is development of inverse models that can be used to determine reservoir parameters.**

# Background/Approach

- **INL has assisted the geothermal industry with using reservoir simulators for many years**
- **Training courses in conjunction with GRC**
- **Publications**
- **Most recently development of inverse modeling capability**

# Background/Approach

- **INL working with developer of PEST code to make it more easily used with reservoir simulators**
- **INL most interested in coupling to TETRAD**
  - **However, can be coupled to other simulators**

# Results/Accomplishments

- **Publications:**
  - **GRC Transactions: 2002**
  - **Stanford Workshop: 2001, 2002 & 2003**

# Conclusion

- **An annotated bibliography of INL reports related to reservoir simulation is being prepared**
- **Project terminated February 2006**

# **Reservoir Characterization for EGS and Hydrothermal Systems**

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# Project Objective

- **Extend tracer analysis methods for enhanced reservoir management.**
- **Develop methods for planning and interpreting tracer tests in geothermal systems**

# EGS Problem

- **As in all geothermal reservoirs, understanding fluid flow is the key to proper reservoir management.**
- **ISSUE: Reservoir operation and management**
- **Better understanding of fluid flow will enable better reservoir management**

# Background/Approach

- INL developed spreadsheet assisted methods to interpret tracer tests
- Currently completing interpretation methods to estimate the spatial distribution of temperature in geothermal environments.

# Results/Accomplishments

- Normalizes tracer concentration history
- Deconvolves the history
- Extrapolates history to long times
- Calculates mean residence time
- Determines pore volume
- Estimates flow and storage capacity
- Estimates reservoir heterogeneity
- Estimates sweep efficiency

# Results/Accomplishments (cont'd)

- **Publications:**
  - GRC Transactions: 2002
  - Stanford Workshop: 2001, 2002 & 2003
  - INL report and spreadsheet, see <http://geothermal.inl.gov/software/index.shtml>
  - PhD dissertation: University of Texas, 2006 by Xingru Wu

# Conclusion

- **Results of UT dissertation will be added to spreadsheet**
- **Project will end September 30, 2006**

# Induced Seismicity

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# Project Objective

- **Original objective**
  - To provide support to Desert Peak field project
- **Modified objective**
  - Application of rock mechanics to fracture evolution and induced seismicity within enhanced geothermal systems

# EGS Problem

- **Resource Characterization and Exploration: Microseisms may be triggered whenever fluids are injected or produced. Proper control of injection and production should prevent noticeable seismic activity, although developing control methods is a challenge.**

# Background/Approach

- **Spatial and temporal evolution of seismic moment tensors can shed light on systematic characteristics of fractures in the geothermal reservoir**
- **When related to observations from laboratory experiments, these systematic trends can be interpreted in terms of mechanical processes that most likely operate in the fracture network.**

# Results/Accomplishments

- **Publications/presentations:**
  - **GRC Transactions: 2005**
  - **Stanford Workshop: 2005, 2006**
  - **AGU 2005**
  - **ARMA 2005 & 2006**
  - **INL reports 2005 & 2006**

# Conclusion

- **Project was completed and final report in edit**
- **Studies should be continued**